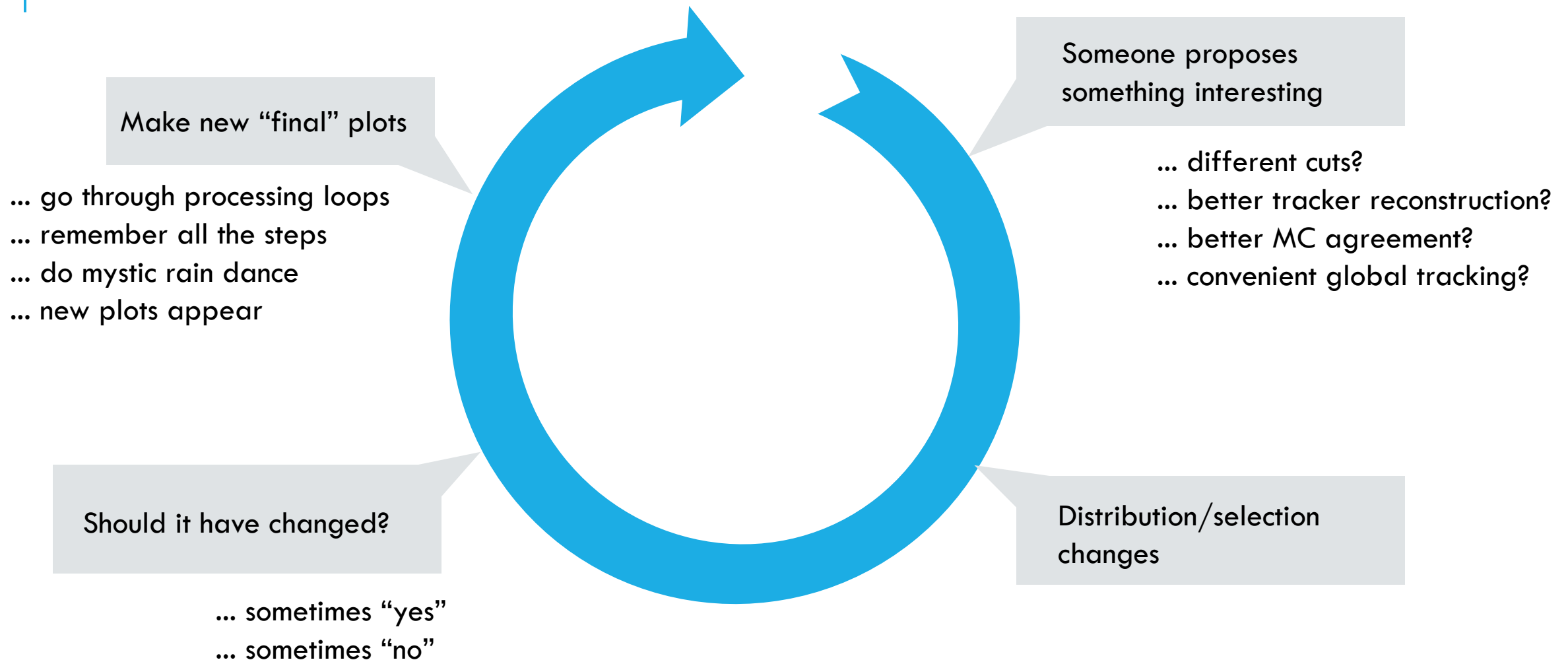


MEASUREMENT OF EMITTANCE

V. Blackmore
CM49
Oct 3rd 2017

THE ANALYSIS LOOP



OLD CUTS, MEET NEW CUTS

'Cut number'	Old Cut		'Cut number'	New Cut
1	Good M. Rayner TOF0 slab calibration		1	Within limits on (tof, tku P) plot
2	Good M. Rayner TOF1 slab calibration			
3	Good M. Rayner TOF reconstruction			
4	Hit 5 stations of TKU		2	TKU radius < 150mm
5	Time of flight between 27 and 40ns	→	3	Time of flight between 27 and 33ns
6	Hit TOF0, TOF1 and 5 stations of TKU			
7	One, and only one, hit at TOF0	→	4	One, and only one, spacepoint at TOF0
8	One, and only one, hit at TOF1	→	5	One, and only one, spacepoint at TOF1
9	One, and only one, track in TKU	→	6	One, and only one, TKU track
10	TKU P-value > 0.01	→	7	Track has $\chi^2 / \text{ndof} \leq 2.5$
11	C. Rogers tracked radius at diffuser < 80mm	→	8	Track has $r \leq 80$ mm at diffuser

MAUS 2.8

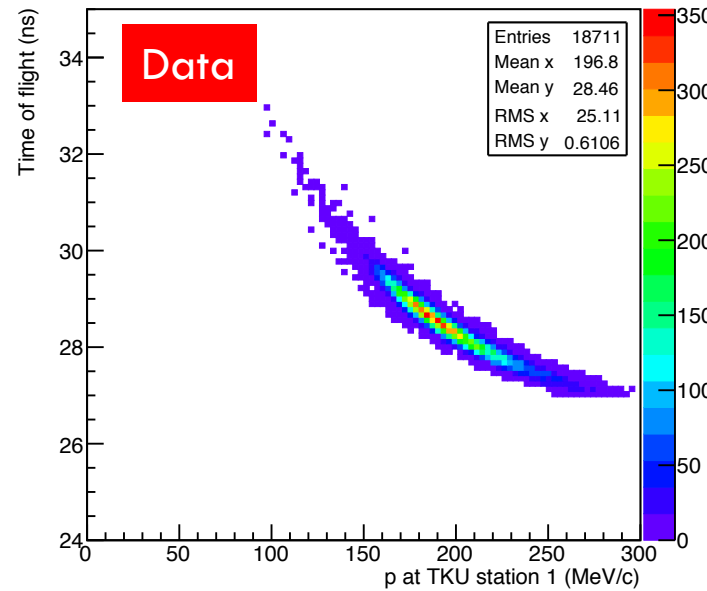
○ What does “**Within limits on (tof, tku P) plot**” mean?

○ $t = L \frac{\sqrt{p^2 + m^2}}{pc}$, to define min and max limits using $p = \langle p \rangle \pm 22\text{MeV}/c$

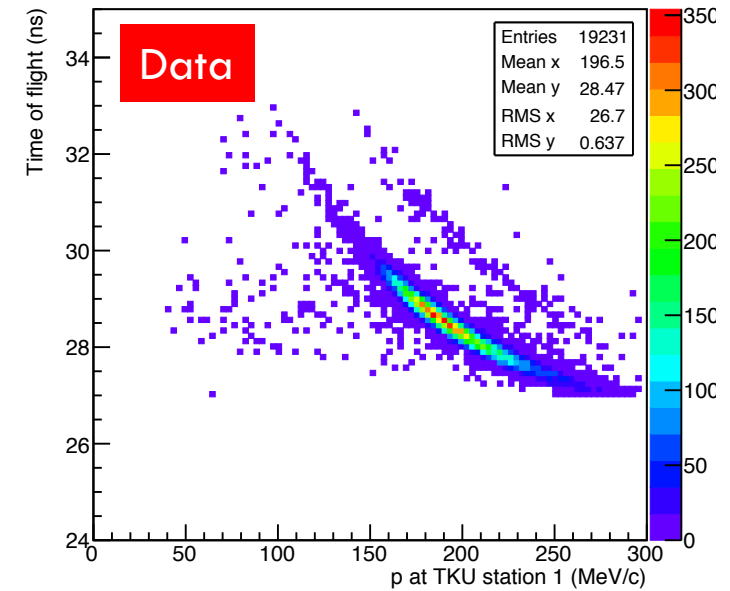
○ Accept if $t_{\min} \leq t \leq t_{\max}$

○ Tidies up particle distribution

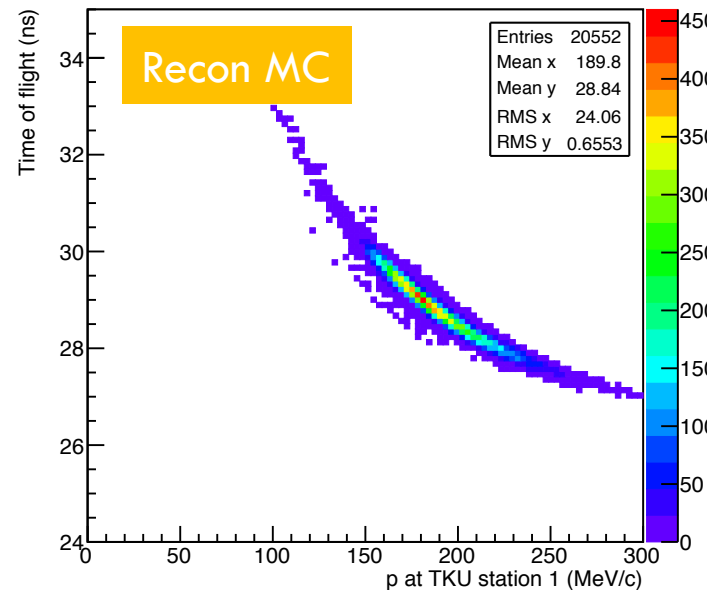
All new cuts



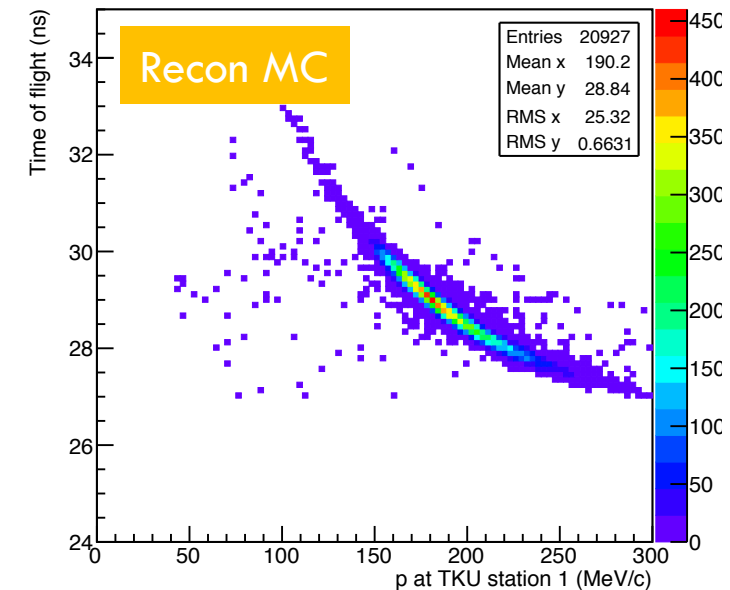
No (tof, tku P cut)



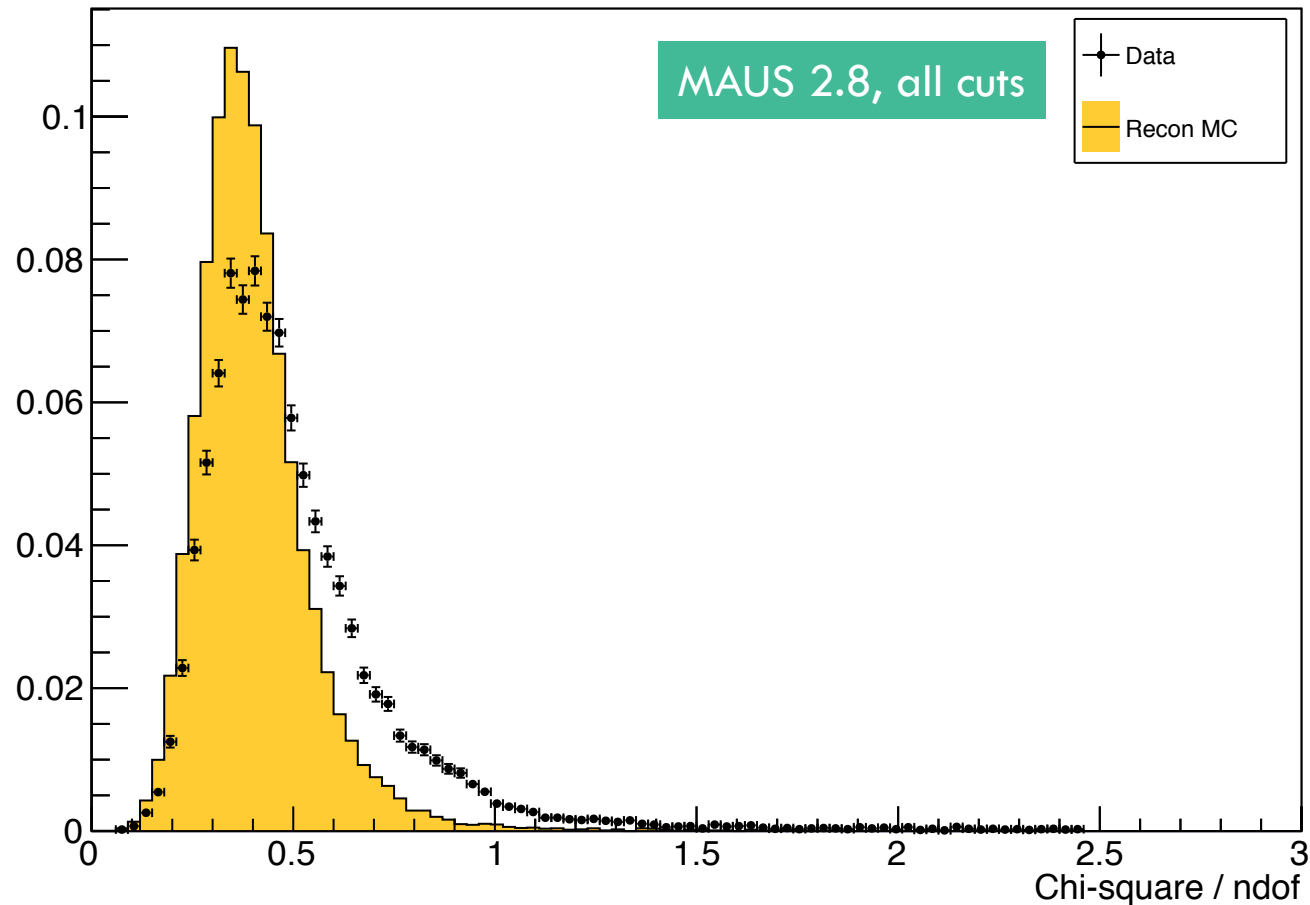
All new cuts



No (tof, tku P cut)

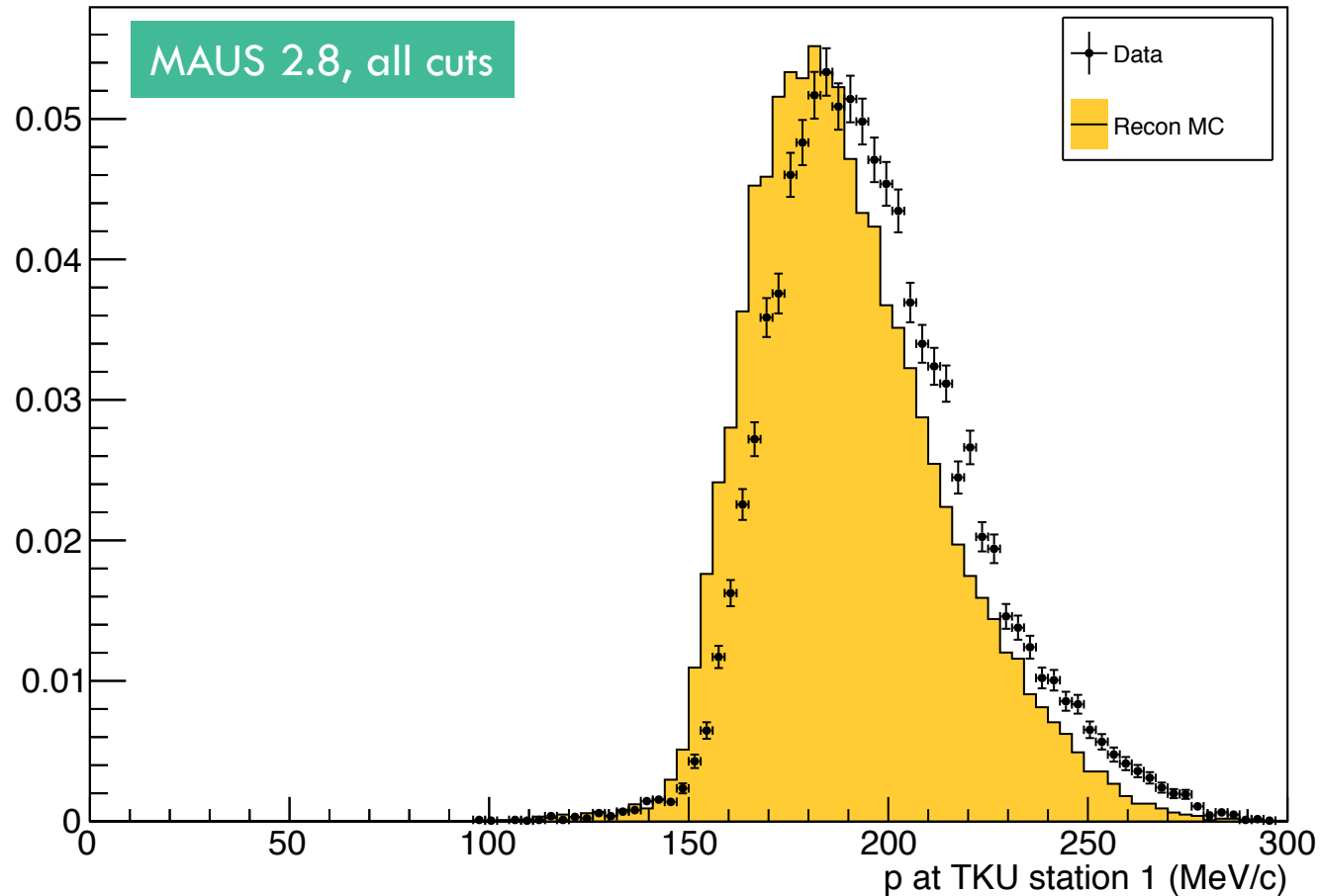


MC, DATA COMPARISONS (MAUS 2.8)



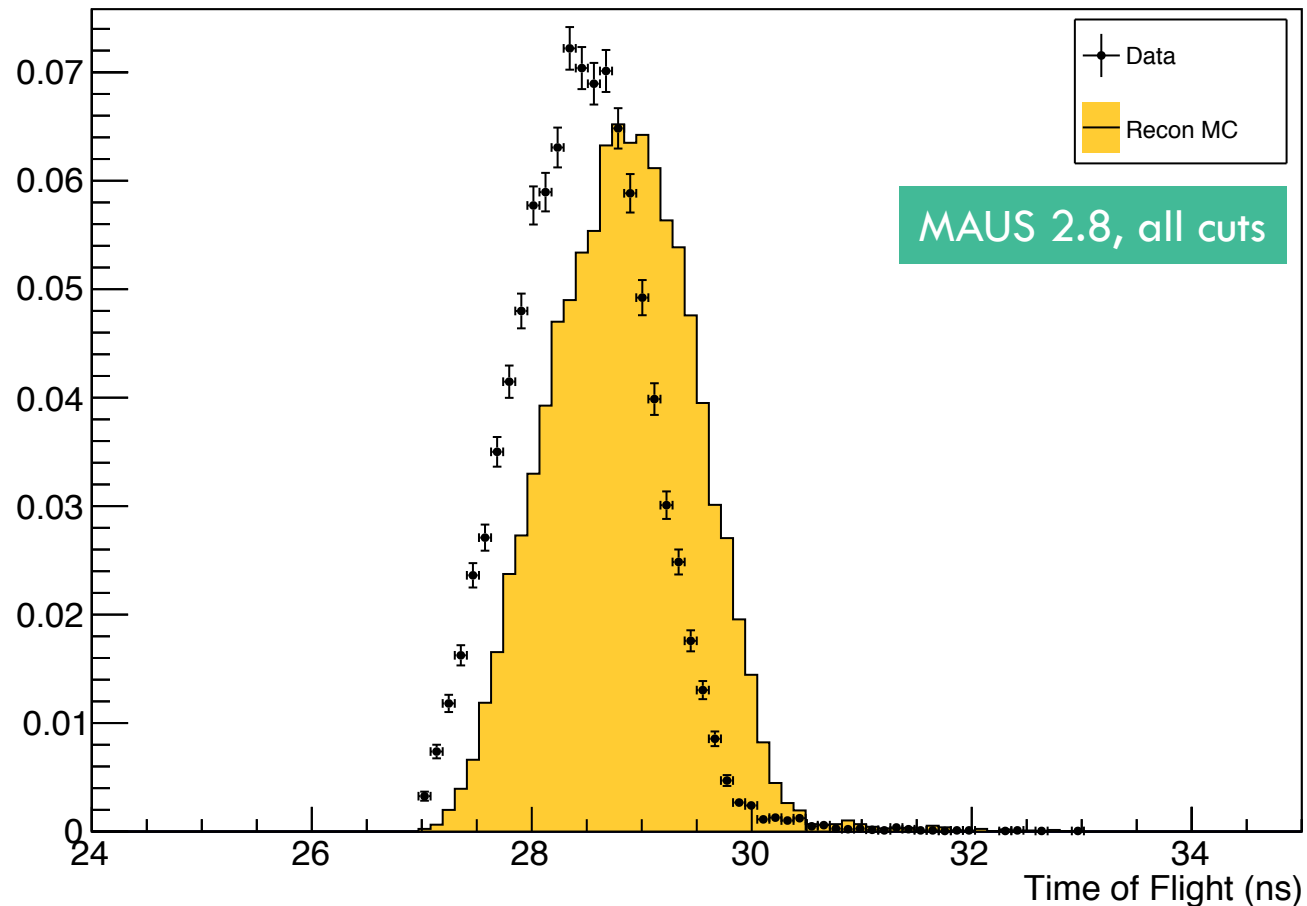
- New distribution to look at
- Replaces P-value in analysis
- Cut on values greater than 2.5

MC, DATA COMPARISONS (MAUS 2.8)



- Still not quite getting $|P|$ in agreement at TKU

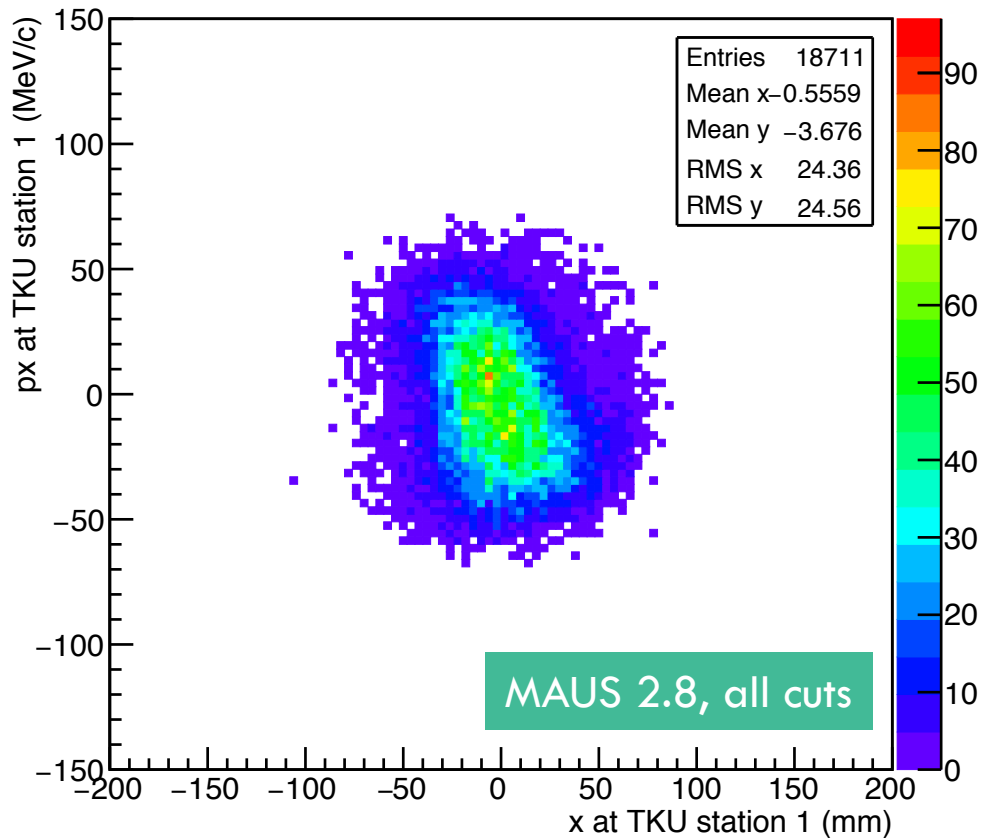
MC, DATA COMPARISONS (MAUS 2.8)



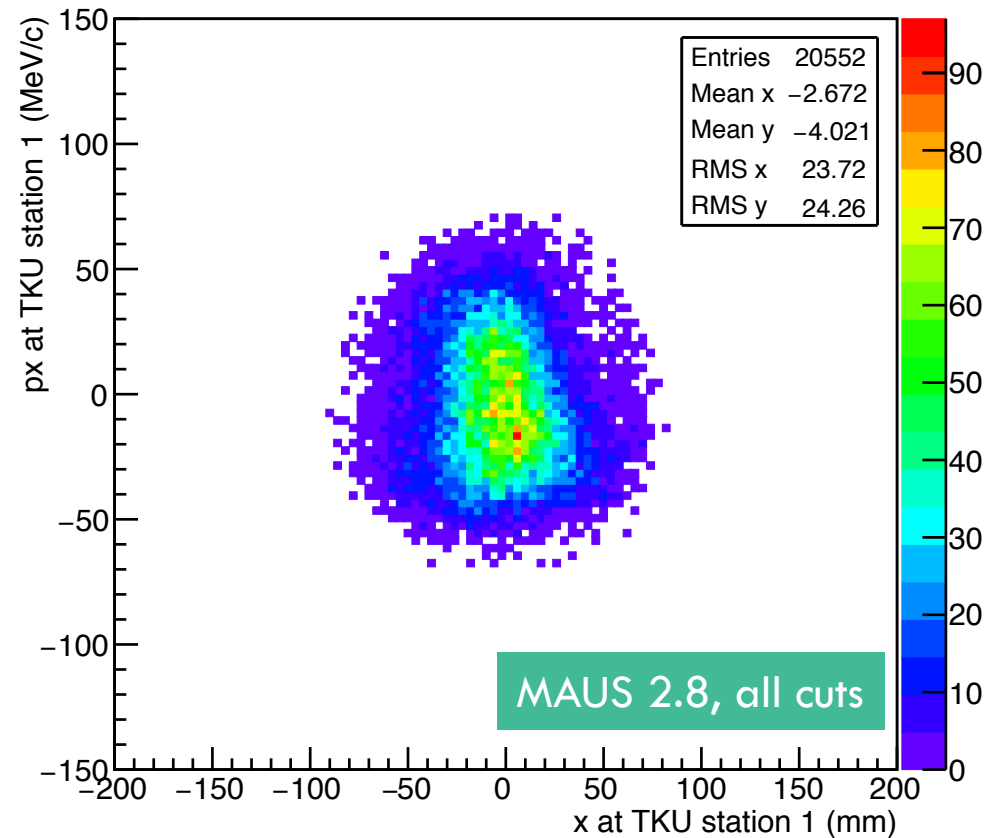
- Still not quite getting time-of-flight in agreement between data and recon MC
- Interesting note: M. Rayner's method to reconstruct $|P|$ at TOF1 shows agreement \rightarrow scales by electron peak

MC, DATA COMPARISONS (MAUS 2.8)

Data



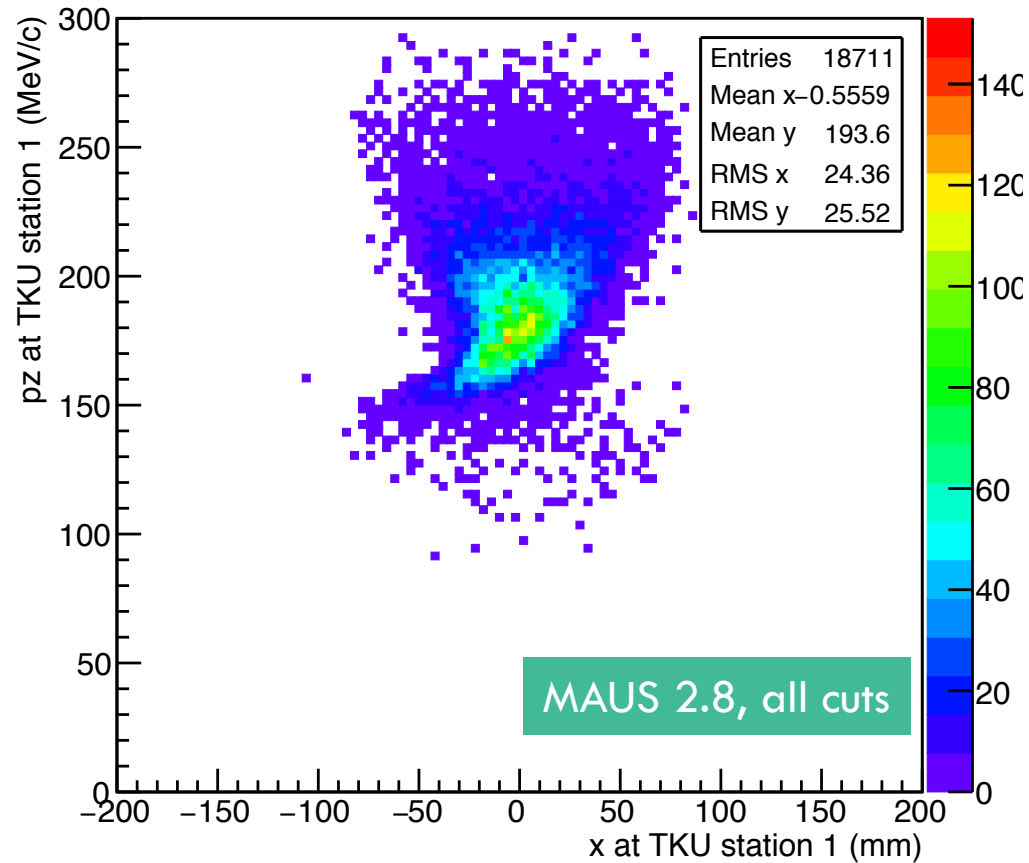
Recon MC



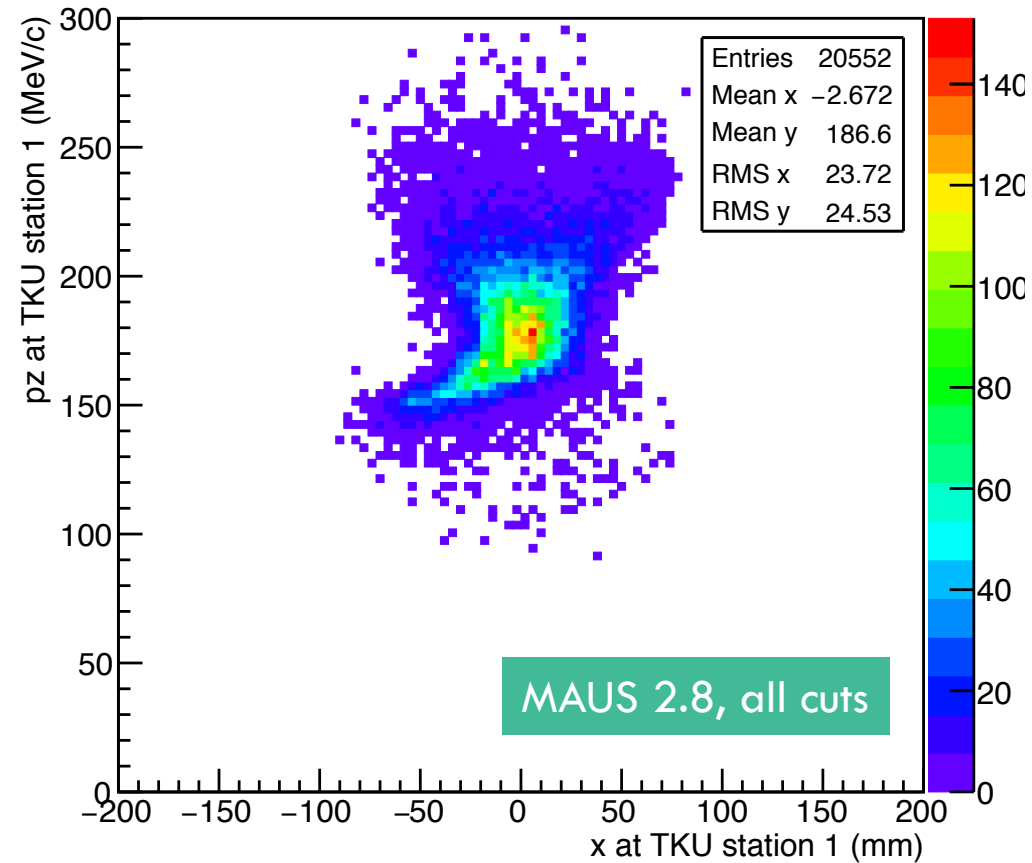
- Similar...

MC, DATA COMPARISONS (MAUS 2.8)

Data



Recon MC



- Similar...

CAN WE IMPROVE MC AGREEMENT?

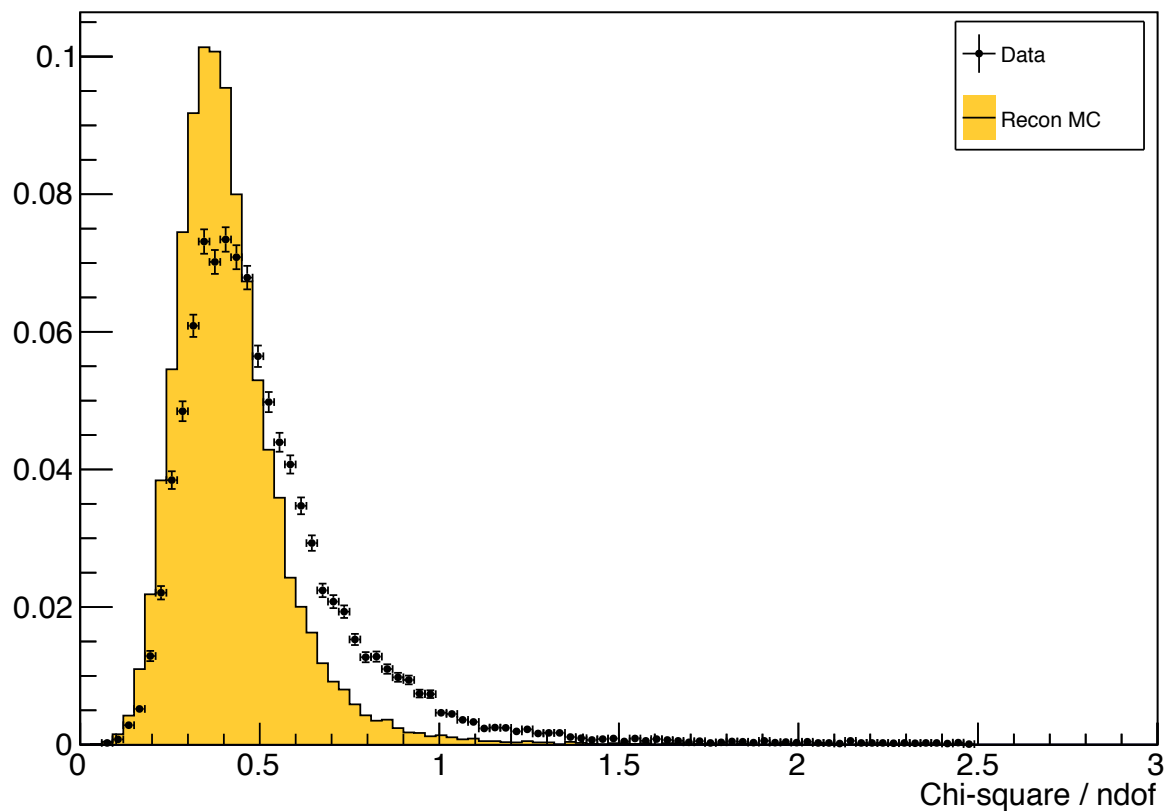
- Durga made 4 different MC's to go with Run 7469
 - Uses MAUS 2.9
 - Data reconstructed with MAUS 2.9
 - Don't have "diffuser tracking", so comparing distributions *without* the diffuser aperture cut (all other cuts remain the same)
 - ... advised to use a MAUS 3.0 reconstruction of data and MC for global tracking
 - ... see "slide 2"

MC nickname	What is it?
"Magic"	The default beamline for Run 7469
"Magic p2"	Default beamline with D2 current + 2%
"Fit"	Beamline using Paolo's D2 current-field fit
"Fit p1"	Using Paolo's D2 current-fit + 1%

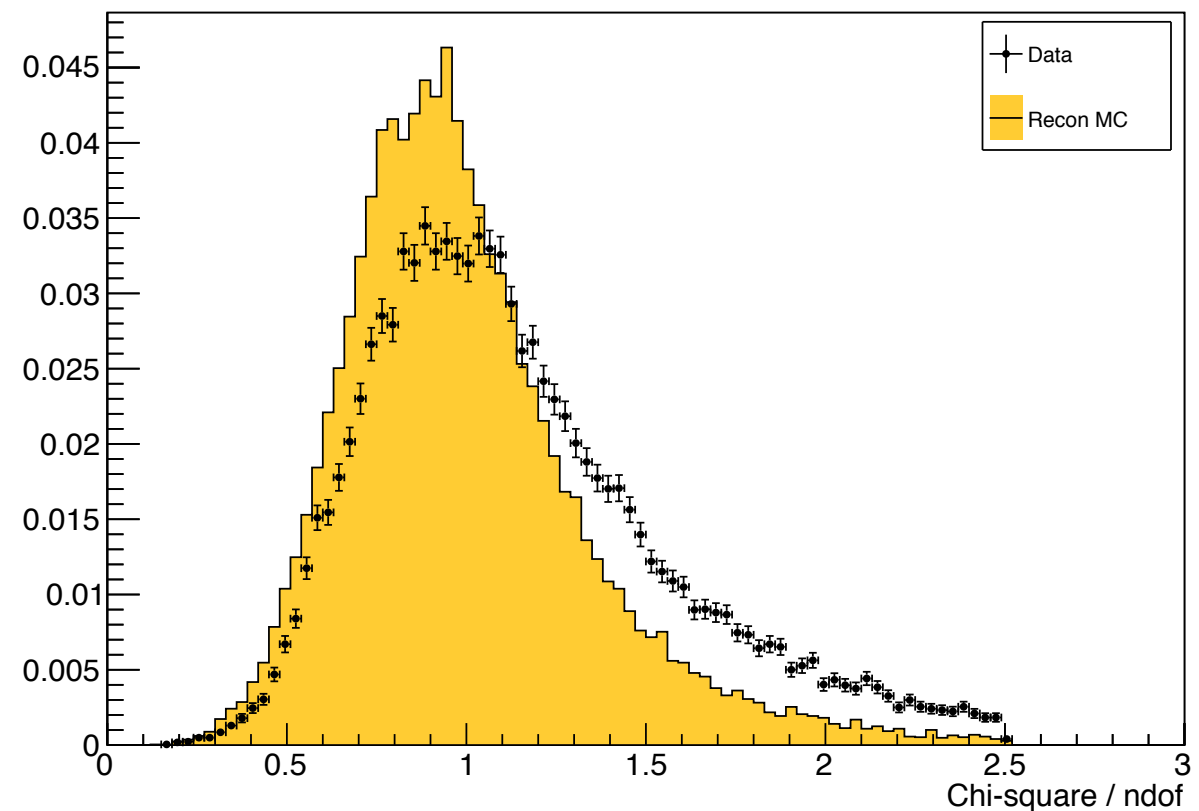
CHI-SQUARE/DOF

Track fitting changed
... and is different again in MAUS 3.0

MAUS 2.8, all cuts except at diffuser



MAUS 2.9, all cuts except at diffuser

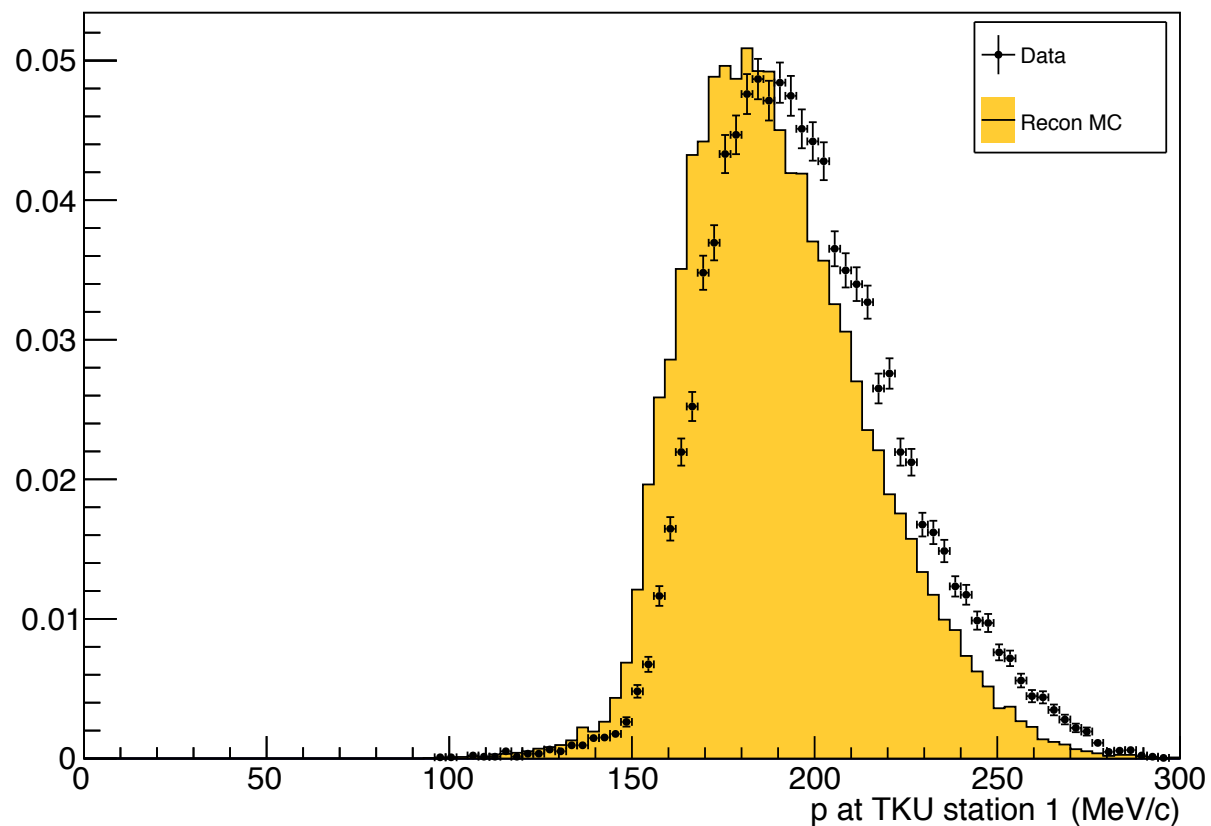


TKU TOTAL MOMENTUM

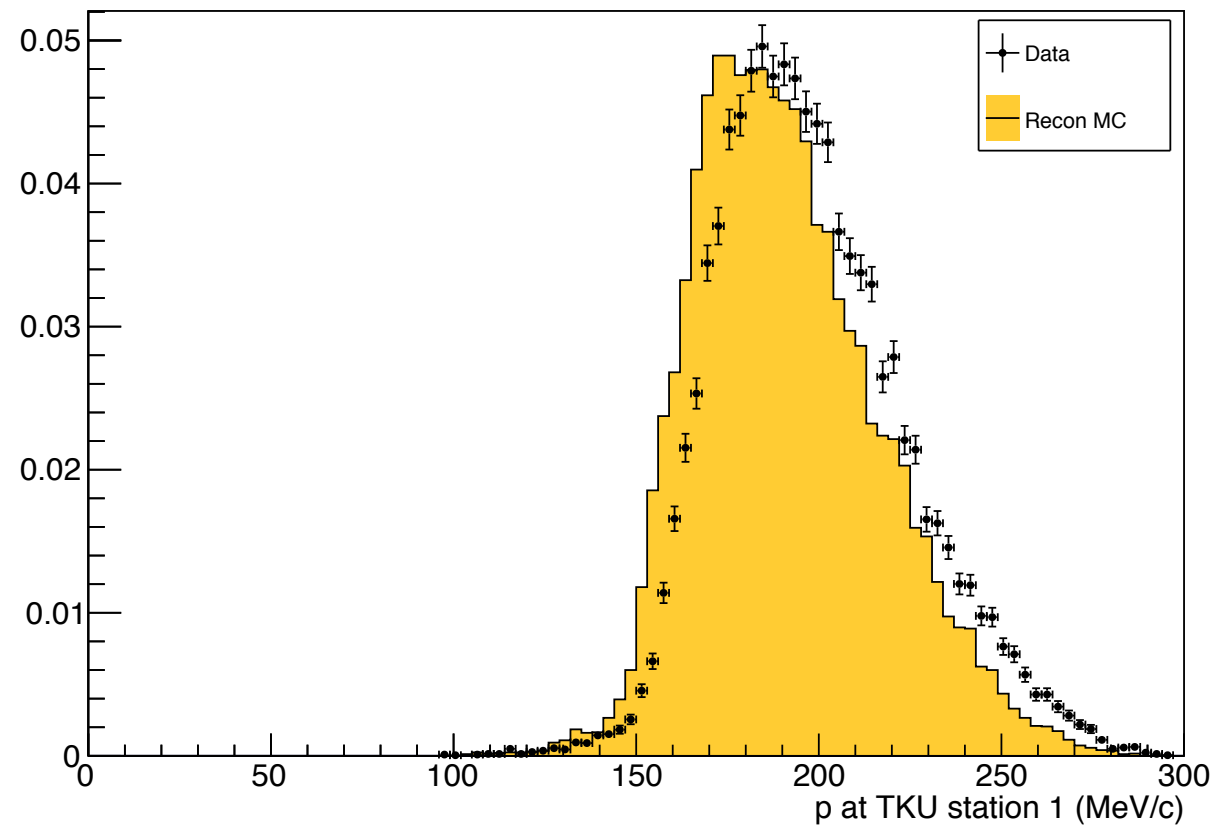
Total momentum at TKU appears similar

... so without fiddling with cuts, what happens to other MC's?

MAUS 2.8, all cuts except at diffuser



MAUS 2.9, all cuts except at diffuser

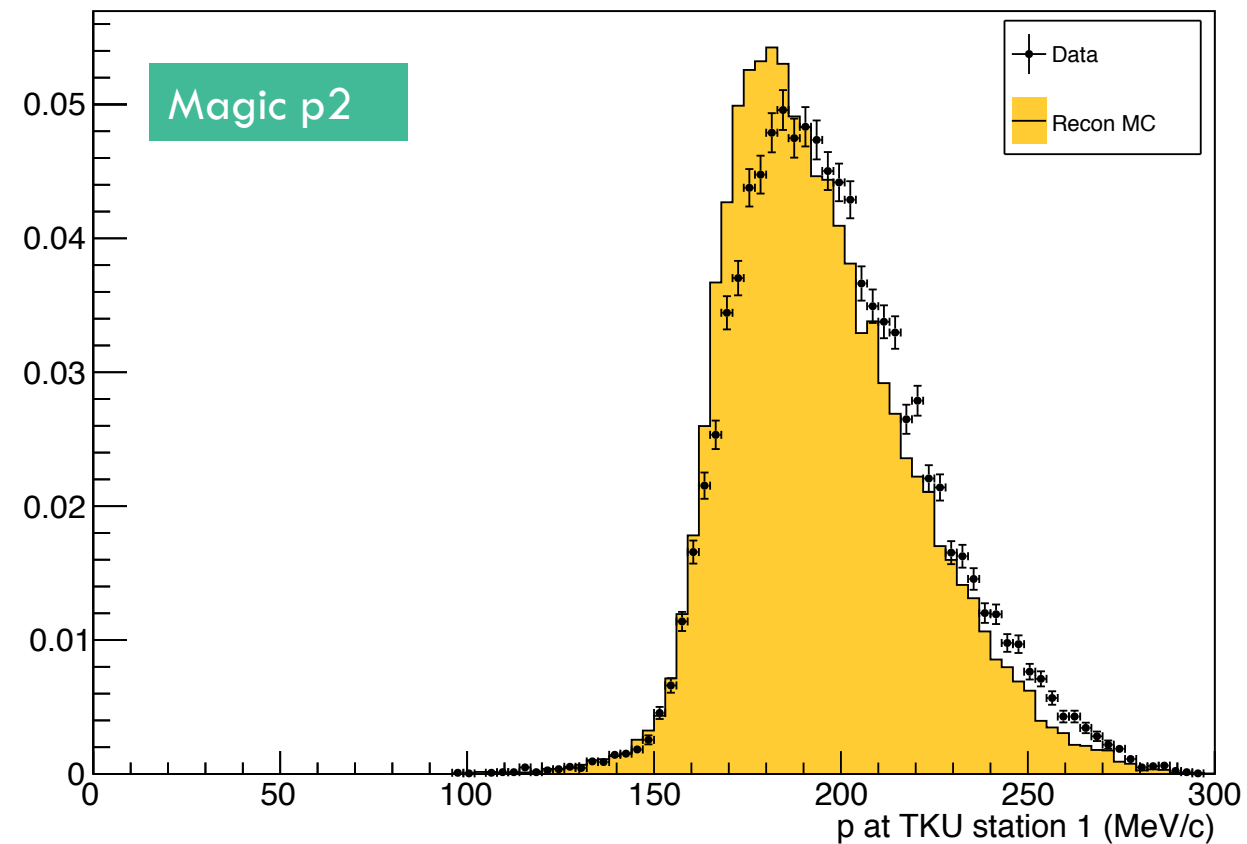
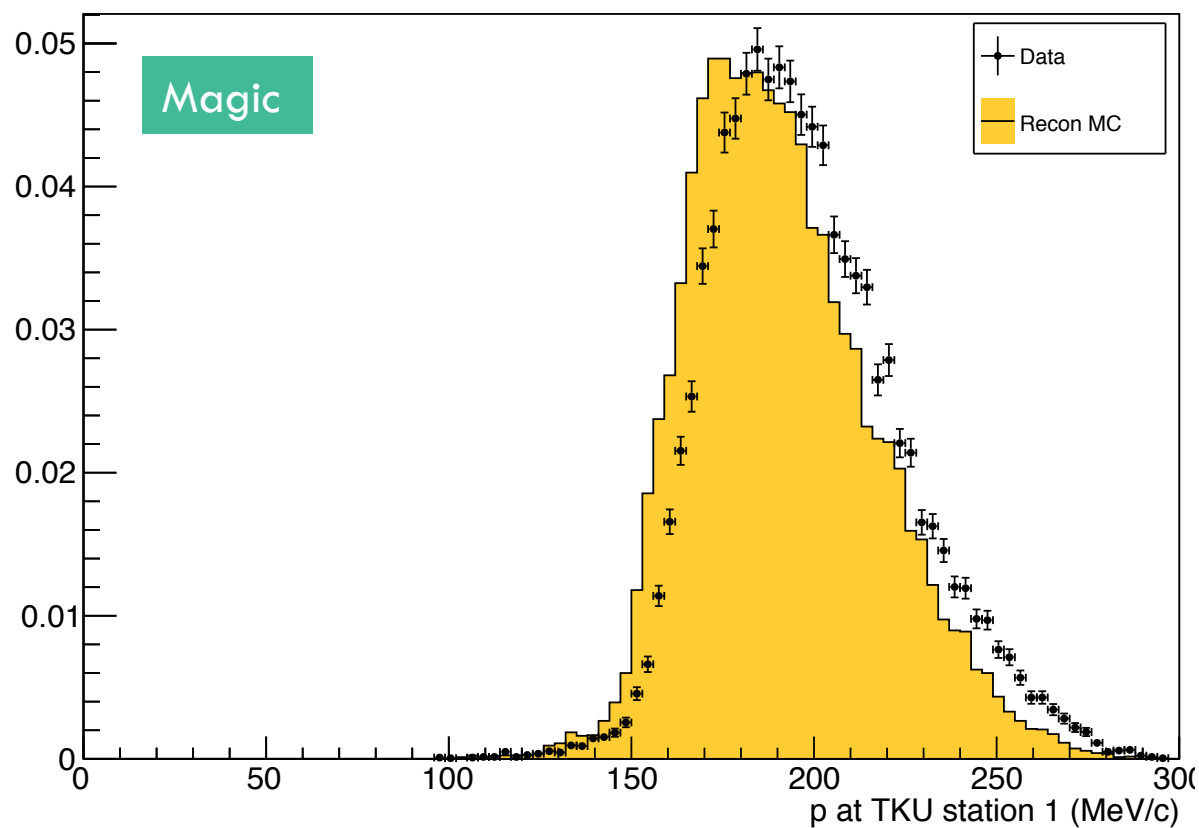


TKU TOTAL MOMENTUM

Total momentum at TKU appears similar

... so without fiddling with cuts,
what happens to other MC's?

MAUS 2.9, all cuts except at diffuser

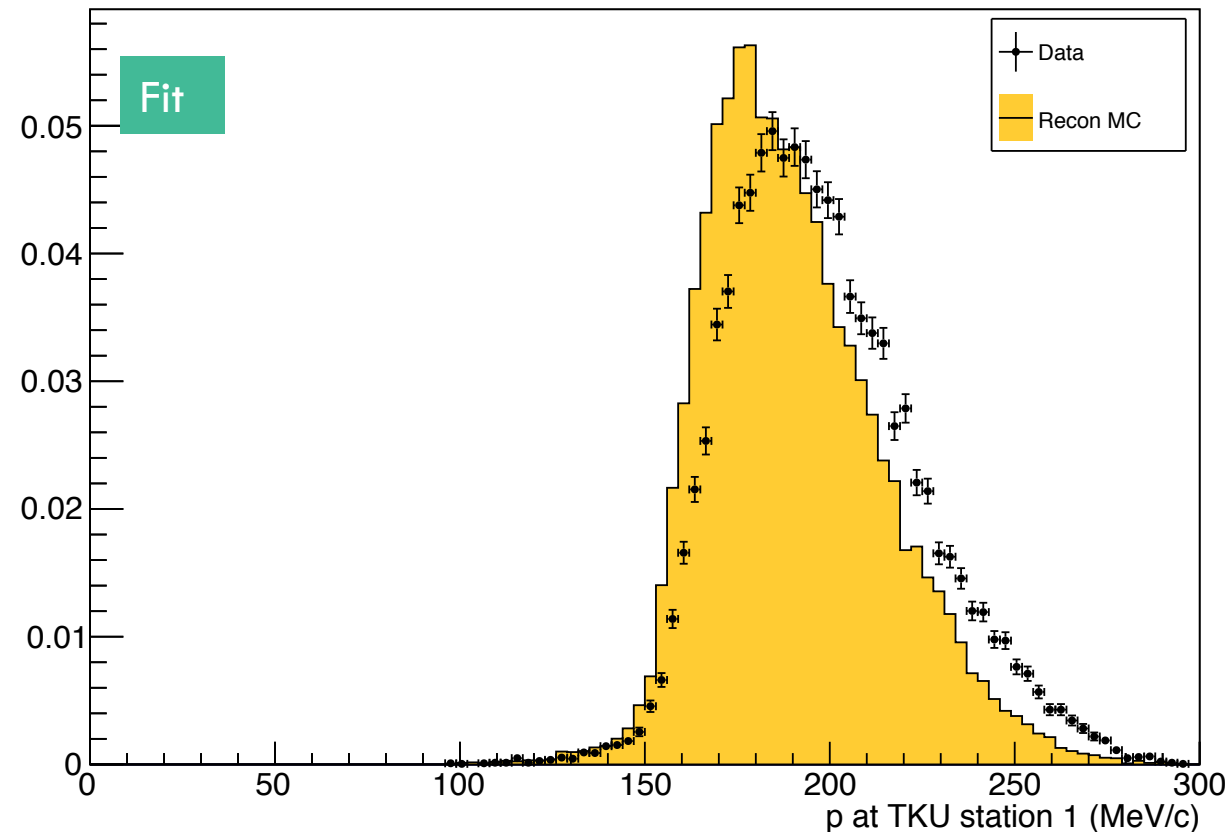
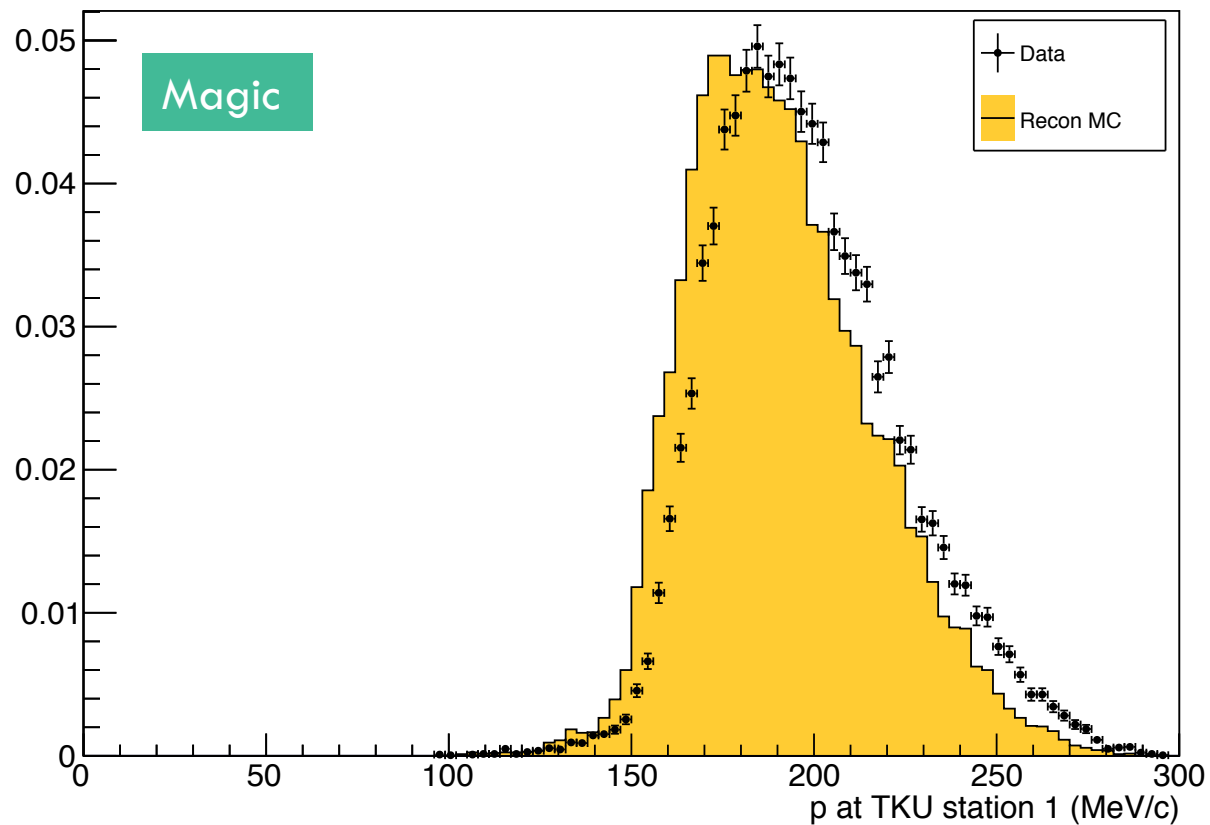


TKU TOTAL MOMENTUM

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MAUS 2.9, all cuts except at diffuser

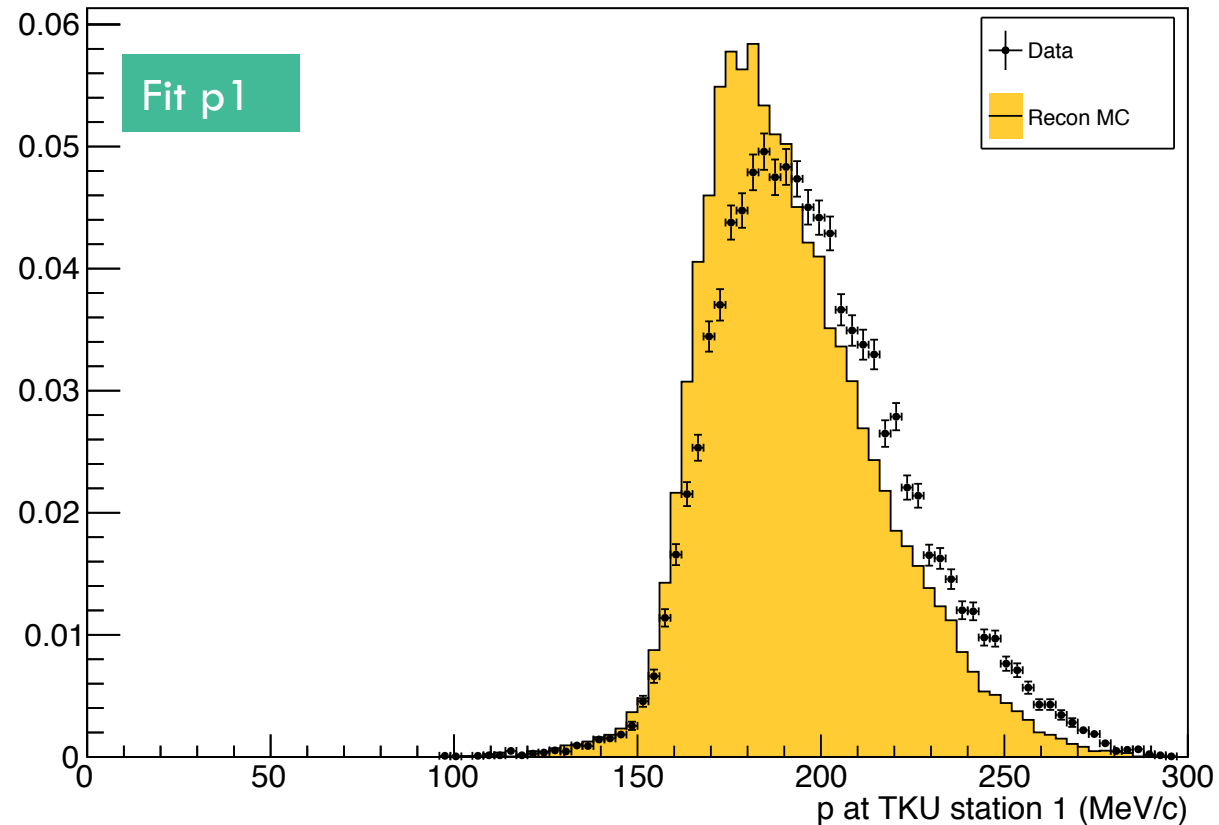
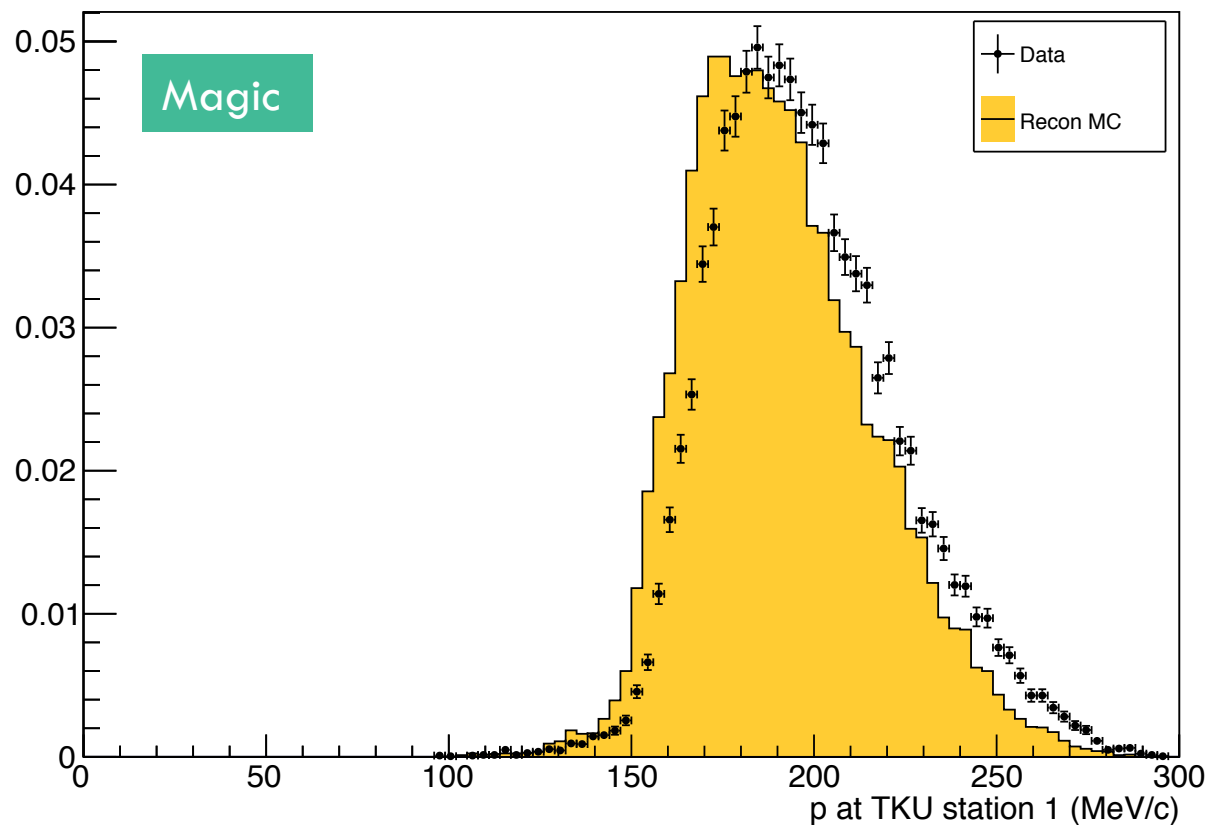


TKU TOTAL MOMENTUM

Total momentum at TKU appears similar

... so without fiddling with cuts,
what happens to other MC's?

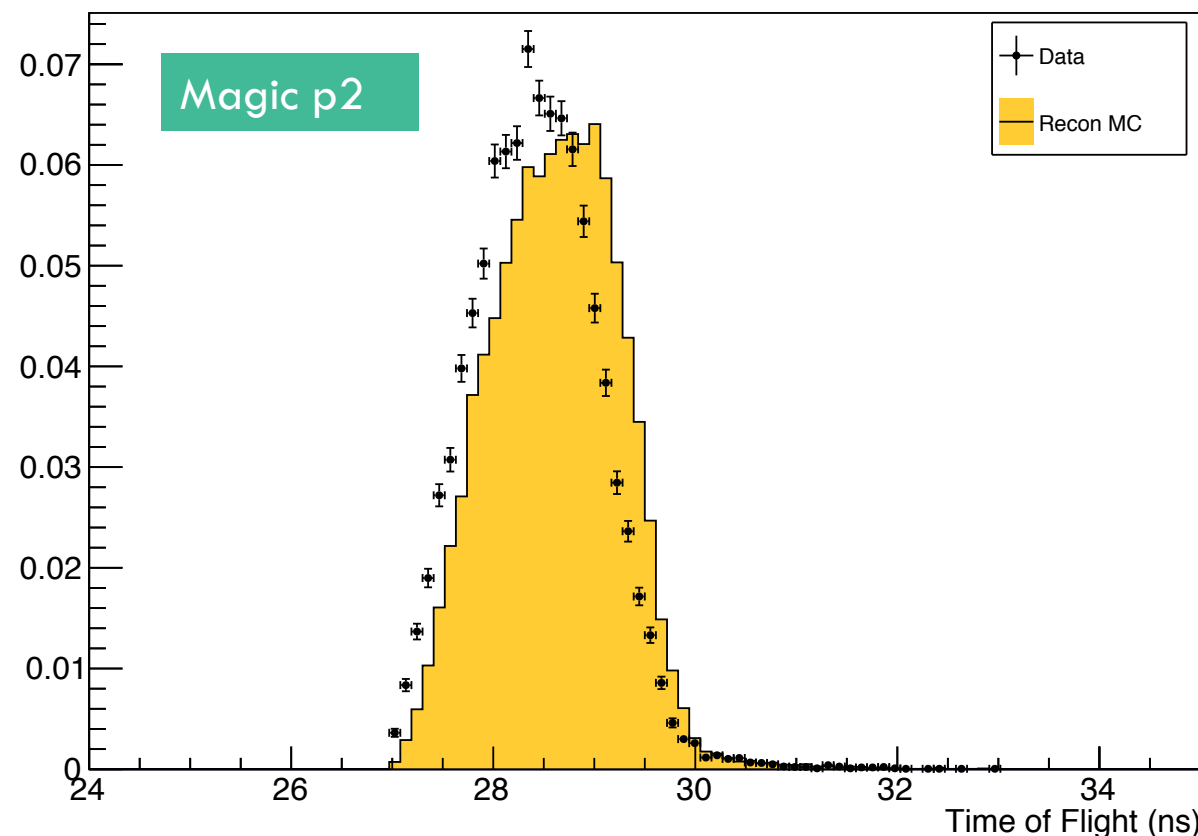
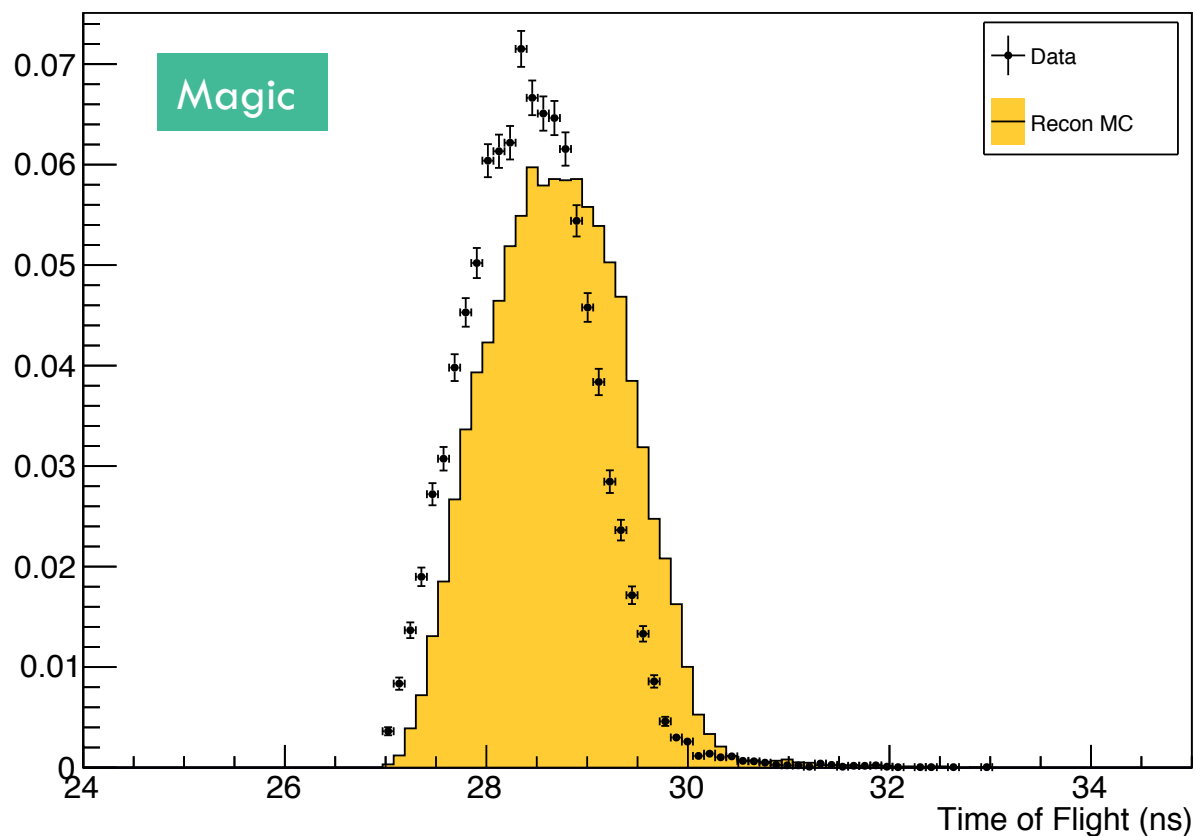
MAUS 2.9, all cuts except at diffuser



(BEST) TIME OF FLIGHT

“Magic p2” captures TKU P best
.. better time-of-flight, but not perfect

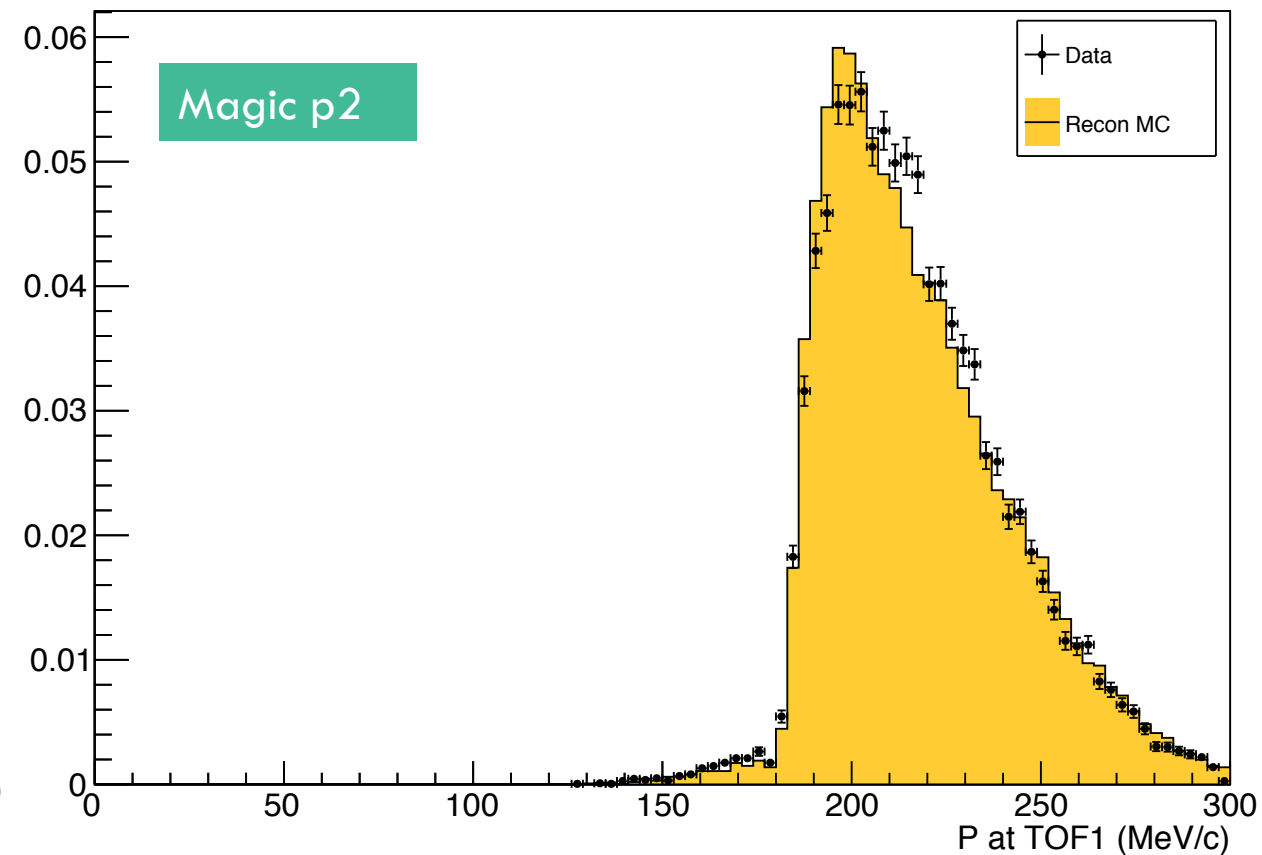
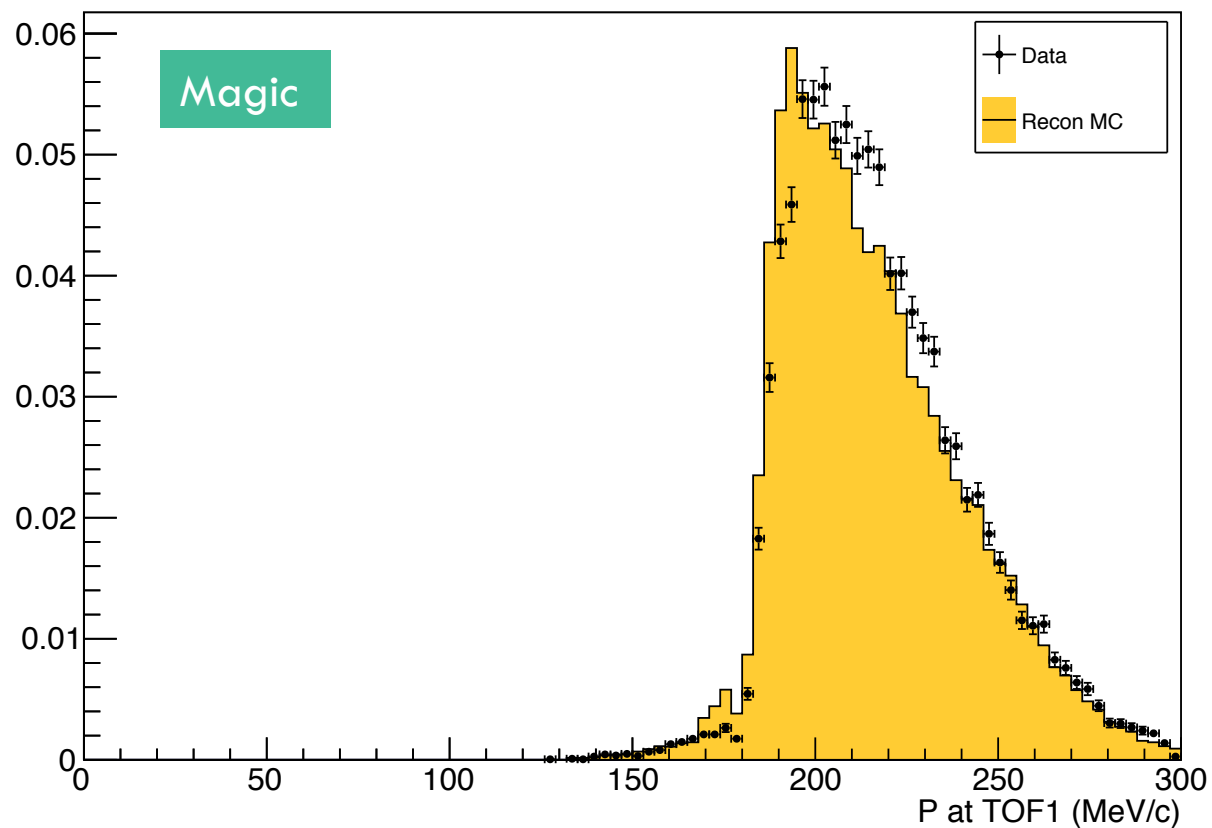
MAUS 2.9, all cuts except at diffuser



(BEST) TOF1 | P |

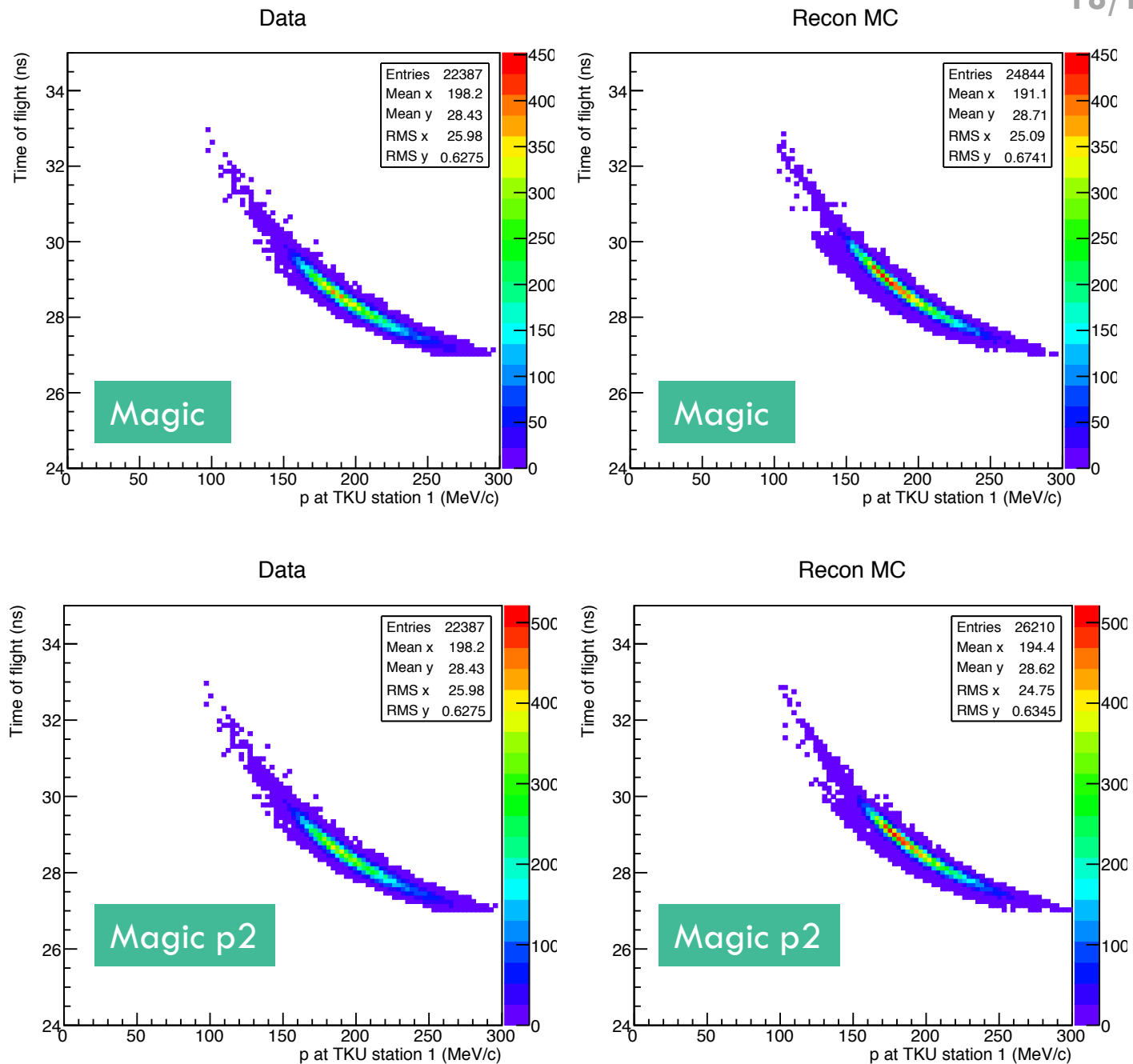
“Magic p2” captures TKU P best
.. better time-of-flight, but not perfect

MAUS 2.9, all cuts except at diffuser



(TOF, TKU | P |)

- Need diffuser aperture cut to improve Recon MC agreement with data



SUMMARY

Data/Recon comparison	# surviving particles after all but “diffuser cut”		# surviving particles after all cuts	
	Data	Recon MC	Data	Recon MC
MAUS 2.8	23,276	26,944	18,711	20,552
MAUS 2.9: Magic	22,387	24,844
MAUS 2.9: Magic p2		26,210
MAUS 2.9: Fit		24,795
MAUS 2.9: Fit p1		25,373

- Going ahead with “Magic p2” for **absolutely, definitely, under-no-circumstances-not final*** processing of data and MC
 - Gains diffuser tracking, better tracker reconstruction
- Concerns:
 - From MAUS 2.8 to 2.9 there’s an overall reduction in particles passing defined cuts
 - Change in chi-square/dof distribution
 - Re-evaluate cut threshold once MAUS 3.0 distribution’s been seen
- With best-available MC, can bin emittance and (fingers crossed) see better agreement between data and MC.